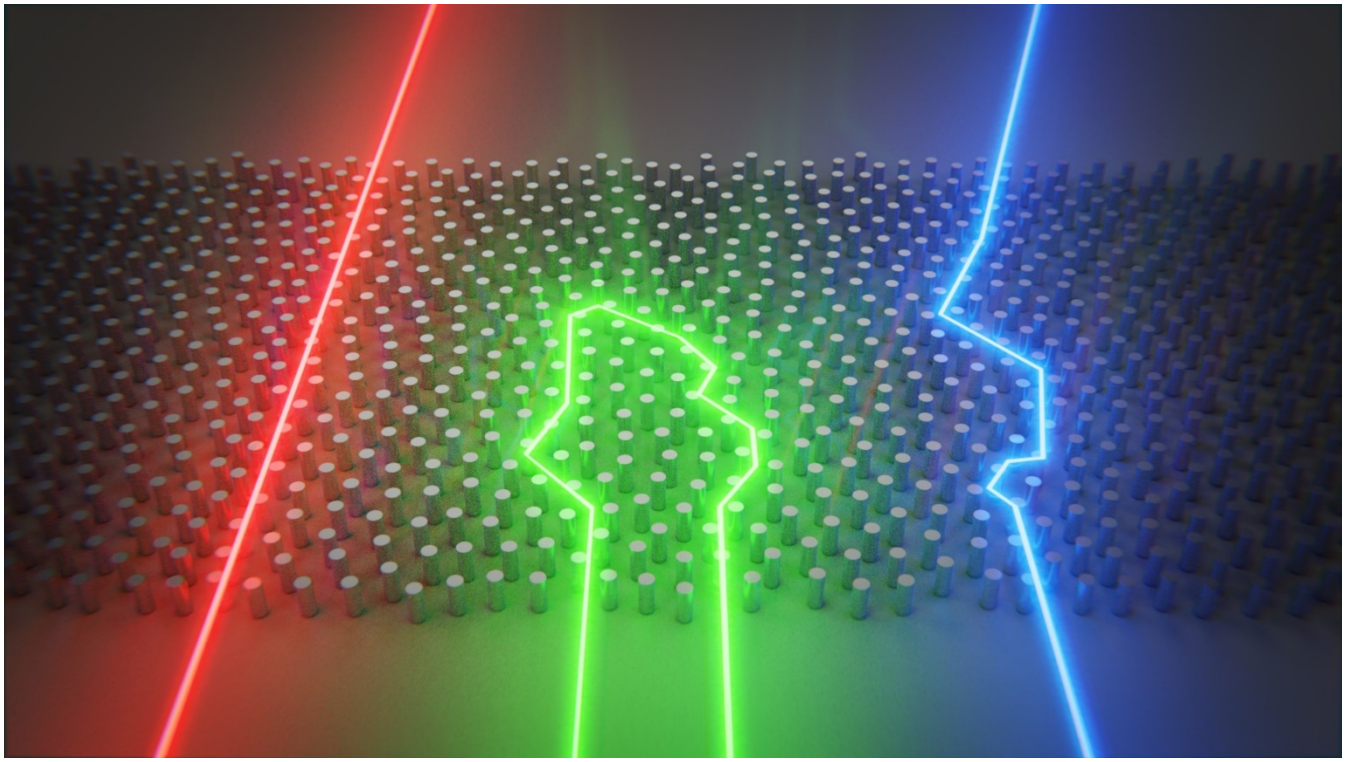
Deciphering the characteristics of disordered photonic semiconductors



The research team of NCCR Bio-Inspired Materials Principal Investigator Prof. Frank Scheffold und Dr. Luis Salvador Froufe-Pérez at the University of Fribourg have been successful in deciphering and systematically classifying the complete optical characteristics of so-called *hyperuniform materials*. Their findings form the basis for the development of photonic, also called optical, semiconductors. Because of their greater speed, they could one day replace electronics in many areas.

The researchers at the University of Fribourg, in collaboration with their colleagues in San Sebastian (Spain) and Erlangen (Germany), used computer simulations to discover that, depending on the strength of the local ordering and wavelength (color) of the light, entirely different optical characteristics can manifest themselves: from transparent to white or completely reflective. These findings form a basis for the design and development of modern amorphous photonic materials based on the concept of hyperuniformity.

Like a fried egg: appearance can change depending on structure

Non-metallic solids and liquids can differ considerably one from the other from an optical point of view. An important role in this is played by the material's structure. One can find clear and transparent materials, but also opaque white or iridescently reflective ones as in the case of opals. Moreover, because of a change in structure, one and the same material can first be transparent and then white, as can easily be observed when frying an egg. In extreme cases, it is possible, within a particular color spectrum, to produce a perfectly reflective material.

Promising semiconductor characteristics

Optical, or photonic, semiconductors play an important role in laser physics. They promise to revolutionise applications in photonics, that is, in the switching and processing of light signals. Because of the greater speed involved, they could perhaps soon replace electronics in many areas.

It has been known for some considerable time that under certain circumstances crystalline structures possess such semiconductor properties. Uniformly disordered (amorphous) materials possessing these special properties were first postulated in 2009 by a group of researchers at Princeton University (USA). These completely novel, computer-conceptualized systems have been known since then as *hyperuniform materials*.

Technical article:

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http://bioinspired-materials.ch/

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